Processing of Thermoplastic Polyurethane Nanocomposite via Reactive Extrusion

[1,2]Khairatun Najwa Mohd Amin, [1]Pratheep K. Annamalai, and [1]Darren J. Martin.

[1]Australian Institute for Bioengineering and Nanotechnology (AIBN),
Corner College and Cooper Rds (Bldg 75),The University of Queensland,
Brisbane Qld 4072 Australia.
[2]Faculty of Chemical Engineering & Natural Resources
Universiti Malaysia Pahang, Leburaya Tun Razak, 26300 Gambang
Kuantan, Pahang D.M. Malaysia.
Phone:+61-07-33463847; E-mail:khairatun.mohdamin@uq.net.au,darren.martin@uq.edu.au

Introduction

Recently, nanocomposites of TPU have been developed with the inclusion of several nanoparticles. This paper demonstrates the preparation of TPU nanocomposites with renewable nanoparticles,microcrystalline cellulose (MCC), Initially, MCC was dispersed in water and was sonicated. The composites have been prepared by dispersing MCC in polyol precursor using a proprietary method, and further polymerized with diisocyanate and chain extender precursors via reactive extrusion processing.

Results and Discussion

In the reactive extrusion process, the MCC volume fraction and isocyanate index were varied. TPU nanocomposites tensile properties were measured, as shown in Figure 1 *(left)*. The tensile strength revealed an increase of approximately 28% with respect to the blank TPU at a very low MCC nanofiller fraction (0.8 wt. %). Results from thermal analysis using differential scanning calorimetry (DSC) (Fig.1 *right*) indicated a slight increase in glass transition temperature (T_g) of the soft segment (SS) microphase with the addition of cellulose. Meanwhile, the broad endotherm (150-200°C) associated with the melting of paracrystalline hard segment (HS) rich regions become broader, suggesting that the very polar cellulose preferentially associates with the HS, and in doing so partly hinders the HS from ordering (**1**,**2**).

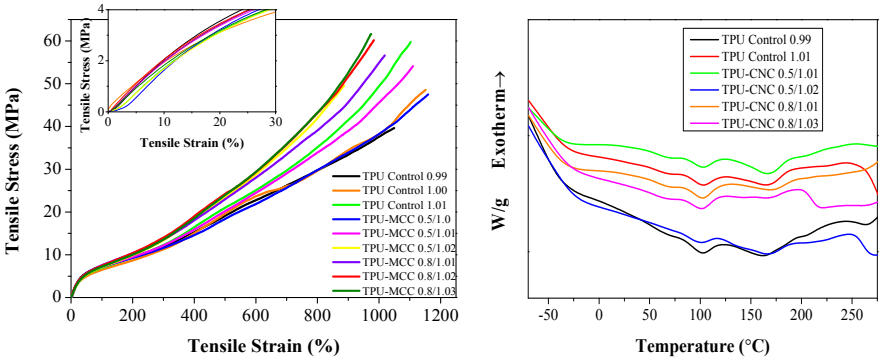

Figure 1:Stress-strain curve (left) and DSC thermograms (right) of TPU/ MCC nanocomposites

Reference

1) Auad, M.L. et al. *J. App. Polym. Sc.* **2010**, 115, 1220. 2) Frick, A. et al. *Polym. Test.* **2004**, 23, 416.